

EARLY WARNING SYSTEM

Central EWS 2005

**Aerial Surveys to Reduce Ship/Whale Collisions
In the North Atlantic Right Whale
Calving Ground**

**FINAL REPORT
2005**

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INTRODUCTION

There are about 350 North Atlantic Right Whales (*Eubalaena glacialis*) in the world, despite international protection since 1937. Failure of the North Atlantic stock to show signs of recovery can be attributed to several factors, including the effects of human activity on mortality rates. Ship strikes account for the largest number of confirmed deaths. Of 62 right whale mortalities documented from 1970 through June 2005, at least 21 (33.9%) were due to collisions with vessels (Knowlton and Kraus, 2001; unpublished data, New England Aquarium). If this source of mortality is not eliminated, recent models predict extinction for right whales (Fujiwara and Caswell, 2001).

The coastal waters of the Southeast U.S. support the only known calving ground for this small population. Right whales typically arrive off the Florida/Georgia coast in December to give birth and begin to depart the habitat by late February and March (although right whales have been documented later than March) to head for the feeding grounds off the Northeast U.S. Vessel traffic within the Southeast U.S. critical habitat is high as three major shipping channels transect the high right whale density area between Brunswick, GA and St. Augustine, FL.

The three major entrance channels serve three commercial shipping ports and two military bases. The channel at the northern end of the high-density area extends 8 nm (14.6 km) offshore and serves the port of Brunswick, Georgia. The channel centered in the area at the GA/FL border is the St. Marys River entrance channel, which runs 14 nm (25.9 km) offshore and serves the Kings Bay Naval Submarine Base, as well as the port of Fernandina Beach, Florida. The southernmost channel is the St. Johns River entrance channel, which runs 4 nm (7.28 km) offshore and serves the port of Jacksonville, Florida and the Mayport Naval Base. This is by far the busiest channel in the area with all forms of large vessel traffic, including container ships, car carriers, tankers, bulk freighters, cruise ships as well as Coast Guard and U.S. Naval vessels. Shrimp boats and recreational vessels are also common and are based out of many small ports along the coast. Commercial vessel traffic in this federally designated critical habitat has increased substantially over the past 40 years (Knowlton et al., 1997). Port expansions and diversions of military traffic to local bases closed elsewhere augment this trend.

The Brunswick and the St. Marys River entrance channels are dredged annually to maintain required depths for large commercial and military vessels that transit the area. This occurs during the winter to avoid impacts to the sea turtles that frequent the area in the summer. Dredged material is usually removed from the channels and carried to offshore disposal sites using ocean-going hopper dredges. These vessels work continuously, often making many transits from the channels to the disposal sites within a 24-hour period. Consequently, dredging activities increase the vessel traffic significantly in these channels and the critical habitat.

Vessel strikes of right whales have been documented in this habitat area since 1988. Five collisions resulted in mortality and were likely caused by large vessels based on the nature and extent of the injuries (an 82 ft Coast Guard cutter mortally wounded a

calf but the vessels involved in the remaining strikes are unknown). Individuals have been observed with propeller cuts from smaller vessels (based on the cut dimensions). These strikes were known to have occurred in the calving ground based on the age of the animal (calf) or before and after sightings of the individual or witnessed events.

During the 1994 calving season (December 1993 through March 1994), the first comprehensive aerial surveys, referred to as the Early Warning System (EWS) surveys, were conducted to locate right whales and provide whale detection and reporting services to all mariners in the calving ground, including the U.S. Navy, the U.S. Army Corps of Engineers, the U.S. Coast Guard, port authorities and harbor pilots. These groups have used the sighting information in their efforts to avoid collisions with right whales.

From 1994 to 2002 the New England Aquarium's (NEAq) EWS surveys covered the majority of the high-density area and provided daily coverage of the three shipping channels within it. Prior to the start of the 2003 calving season, surveys in the Southeast U. S. were redesigned to allow for more daily coverage of a larger area. Beginning in 2003, the NEAq's EWS surveys were extended eastward 30-35 nm (54.8-63.9 km) from the coast and reduced in latitudinal range. The area includes the St. Marys River entrance and the St. Johns River entrance. This redesigned survey area is referred to as the Central EWS survey area.

In addition, beginning with the 2004 calving season survey aircraft and crew used during the EWS surveys were subjected to newly imposed minimum safety standards. Survey aircraft were all certified under 14 CFR, Part 135 (airline, aircraft less than 10 seats). In addition, pilots and observers underwent intense pre-season training. Observers and pilots attended aircraft ditching course and sea survival training. Pilots also attended FAA Part 135 ground school and passed all associated check rides. A second pilot in command (SIC) was also added to each survey flight to ensure a higher safety margin during survey operations. The addition of the SIC limited the recording ability of the surveys that were conducted in a Cessna 337 due to weight and balance constraints. For this reason all surveys flown during the 2005 season were conducted without a dedicated data recorder.

This report describes the results of the Central EWS right whale aerial surveys during the 2005 season (December 1, 2004 – March 31, 2005). The U.S. Army Corps of Engineers, U.S. Coast Guard and the U.S. Navy provide the funding for Central EWS surveys with support from NOAA Fisheries.

METHODS

Aerial Surveys

Surveys were flown daily from December 1, 2004 through March 31, 2005. The surveys extended southward from approximately 6.5 nm (12 km) north of the St. Marys River entrance, to Jacksonville, FL, approximately 6.5 nm (12km) south of the St. Johns River entrance. Twelve east/west transects were flown perpendicular to the coast 3 nm (5.5 km) intervals from 0.5 nm (0.9km) off the shoreline out to 30-35 nm (54.8-63.9 km) from the shore. A total of 406 on-transect nm (761 km) were flown during each completed survey.

Necessary conditions for all flights included a minimum ceiling of 1000 feet (305 meters), visibility greater than 3 nm (5.5 km) and winds less than 17 knots. Surveys were conducted in a 14 CFR Part 135 certified twin engine Cessna 337. The aircraft was equipped with GPS, full IFR (instrument flight rules) instrumentation, aircraft mounted marine radio, life raft, medical kit, a waterproof handheld VHF marine radio, a registered removable 406 mHz EPIRB (Emergency Position-Indicating Radio Beacon), aircraft mounted ELT (Emergency Locator Transmitter), satellite phone and 4 emergency immersion suits (when water temperature reached below 50 degrees Fahrenheit).

The survey was flown at an altitude of 1000 feet (305m) above sea level. The survey team consisted of a pilot in command (PIC), pilot second in command (SIC), and two observers positioned on each side of the aircraft in the rear seats. Each observer was individually equipped with, but not limited to a Nomex flight suit, FAA approved survival vest, strobe light, rescue streamer, combo-edge knife and Personal Locator Beacon (PLB) with GPS. The observers scanned the water surface out to at least 2 nm (3.7 km). In order to maintain standardized sighting effort, the PIC and SIC were instructed not to alert the observers to any sightings, but were allowed to report a sighting and break track after it had been passed by the aircraft if missed by the observers. The distance of each right whale sighting from the flight track was measured using GPS positions of the sighting and the transect line.

All sightings (whales, ships and environmental conditions) were recorded into a digital voice recorder while on survey effort and entered into a computerized logging program at the end of each survey. Logger 2000 was created by International Fund for Animal Welfare (IFAW) and designed for compatibility with the Right Whale Consortium database, curated by the University of Rhode Island (URI). During surveys, every 10 seconds Logger 2000 would download the time, position (latitude and longitude), altitude, heading and speed of the aircraft into a database. In addition to the automatically downloaded data, the recorder could manually enter sighting information into the database. Beaufort, visibility, cloud cover and weather were also recorded. Due to the change in configuration of aircraft personnel with the addition of the SIC and loss of the data recorder position no other marine species sightings were logged during flights except basking sharks and leatherback Turtles. These two species were logged because

of requests by researchers. All sightings of vessels visually estimated to be larger than 100 ft (30.5 m) were recorded. Vessels that are no longer recorded due to the loss a dedicated recorder include commercial fishing vessels and recreational vessels.

When sightings of right whales occurred, the aircraft left the transect line at a right angle to the sighting and flew directly over the whale(s) to obtain an exact GPS location of the whale(s). The aircraft then circled the whale(s), allowing observers to obtain photographic identifications of the individuals sighted. High-resolution digital images were obtained at an altitude of 1000 ft (305 m) using a digital Nikon D1X camera with a fixed 400mm Nikkor lens. At the conclusion of photographic work on each sighting, the aircraft returned to the transect line at the point of departure. These methods conformed to research protocols followed by the North Atlantic Right Whale Consortium as approved by NOAA Fisheries.

Notification of Agencies

During the Central EWS season, all right whale sightings were reported to the Fleet Area Control and Surveillance Facility at Naval Air Station Jacksonville (FACSFACJAX). Using satellite phones right whale sightings were reported directly from the survey aircraft to a ground contact that relayed the information to FACSFACJAX. This near real time data is forwarded to the NAVTEX system via the U.S. Coast Guard (USCG), and is received automatically by all military and commercial shipping. The USCG also transmits Notice to Mariners over VHF marine-band radio channel 16. A right whale user group, which includes local, state, federal, non-profit and commercial interests is provided with pagers and receives sighting information from FACSFACJAX almost immediately via the pager system.

Photographic Identification

Photographers attempted to obtain high quality images of the entire callosity pattern of every right whale and any other scars or markings that were obvious on the body. Time spent photographing right whales was limited to ensure completion of the survey. The image numbers were recorded by date, time, right whale letter for the day and photographer. Digital metadata time was synchronized to the GPS and the computer-logging program (Logger 2000) times at the start of each survey for accuracy.

Photographs of right whale callosity patterns were used as a basis for identification and cataloging of individuals, following methods developed by Payne *et al.* (1983) and Kraus *et al.* (1986b). Photographs taken during the survey effort were used to classify individuals on the basis of callosity patterns, topography, pigmentation and scars. Final matches will be confirmed using photographs from the North Atlantic Right Whale Consortium database, archived at NEAq.

One or two good quality digital images of each right whale considered to be a new individual for the season were emailed to the NEAq office in Boston for preliminary

identification. The identifications were shared with the NEAq team as well as other researchers from Associated Scientists at Woods Hole, Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute (FWRI), Marineland, Marine Resources Council and Wildlife Trust (all of which also sent images to NEAq for preliminary identifications). This allowed for an up-to-date tally of the number of mother/calf (M/C) pairs during the season. Intermatching of non-mother/calf pairs was also initiated during the season. Photographs of all individuals were downloaded at the end of the day to look for entanglement or other injuries.

Distribution

Sightings of all right whales were recorded by time and location within the study area. Integration of the right whale sightings data collected during these surveys with previously collected data will help to further identify high-use areas within the southeast region. All right whale sightings for the season were plotted and displayed as M/C pairs, 1-7 whales and groups of 8 or more right whales. Sightings were plotted for the four-month long season and also plotted by month so that temporal distribution can be discerned. In addition, ship traffic was also plotted to visually compare right whale sightings versus ship traffic recorded by the aerial survey effort.

Sighting Distance

Sighting distance for each right whale sighting event was also determined. The distance was calculated by using the exact GPS position of the whale(s) and the exact position of where the aircraft broke from the transect line, also determined by GPS. Sighting events that occurred while the survey aircraft was not on transect were not included in the analysis.

Demographics

An analysis of the sex and age composition of the 2005 wintering population of right whales in the survey area was conducted using data from the aerial surveys and the existing catalog of identified right whales from the western north Atlantic. Right whales previously identified in their calving year were classified as juveniles (1-8 yrs) or adults (≥ 9 yrs). Whales that were not first sighted as calves were classified as unknown age until their ninth year in which they become classified as an adult. All calving females were classified as adults regardless of age. Sexes were determined by one or all of the following methods: 1) direct observation of the genital area 2) association with a calf 3) by the testing of biopsy samples for a genetic marker unique to the Y chromosome (Brown *et al.*, 1994).

Calving Intervals and Rates

Right whale cows (reproductive females) in this population have been monitored since 1980, and records of calf production are documented in the North Atlantic Right Whale Catalog (Kraus *et al.*, 2001). Data collected on right whale cows that gave birth in the study area during the survey period were used to update information on calving intervals, rates of reproduction, time frame and location of calving.

Associations and Behaviors

The survey team remained on site until quality images of each whale in the sighting were obtained. During this time all visible associations and behaviors were recorded with as much detail as possible. The whale(s) heading was also recorded.

The time spent at each sighting is directly correlated to the survey team's ability to obtain photographic documentation of the event. Once the digital images were obtained, the survey aircraft returned to effort regardless of the whales' association and/or behaviors. The exception was made in the event of a ship/whale interaction or "close calls", entanglement and events that caused concern for the welfare of the whale(s) (whales in a shipping channel or river).

Whales are considered associated if within several body lengths of each other and coordinating their movements at the surface (Hamilton, 2002). Associations were described as one of the following types.

1. Surface Active Group (SAG)
2. M/C
3. Echelon feed
4. Other
5. Not associated

Behaviors were also recorded when observed. Photographers attempted to capture photographic evidence of the behaviors for later confirmation.

A whale or group of whales was also given a heading if it was determined that the whale(s) had traveled a significant distance while the survey team was on site.

Vessel Sightings

All large vessels, greater than 100 ft (30.5 m), sighted during a survey were entered into Logger 2000. The aircraft did not break track during large vessel sightings in order to maximize time available for survey effort. The position (latitude and longitude) of the aircraft was recorded when perpendicular to the vessel. The vessel was recorded with a bearing, visually estimated distance from the aircraft and the vessels heading. The vessel's position was later calculated using the estimated distance from the aircraft's position and these data were maintained in a separate database.

Vessels recorded included commercial and military vessels. Small commercial vessels were also recorded; this includes tugs, pilot boats and dredge crew and survey vessels. All entries include type of vessel, time, converted latitude/longitude position and

heading. During a sighting, if a vessel was determined to have the potential for a “close call” with a whale or group of whales the vessel was contacted directly by the survey aircraft in an attempt to prevent the threat of an interaction. When “close call” events occurred the survey team would record detailed information about the situation. Data collected included type of vessel, vessel’s position, whale’s position, whale’s reaction (if any), closest distance between whale and vessel, radio communication (if any) between aircraft and vessel, vessel’s actions (course change or speed change). All “close call” events, regardless of vessel type (commercial, military, recreational or commercial fishing) and estimated vessel size were reported at the conclusion of the survey to NOAA Fisheries. In addition, all “close call” reports were compiled and forwarded to Florida Conservation Commission (Fish and Wildlife Research Institute) at the end of the season for inclusion in the close call database.

EWS RESULTS

Survey Effort

The survey team was on-site for 121 days (1 December 2004- 31 March 2005) during the right whale calving season. During the 2005 season 78 surveys were conducted. The first survey was conducted on December 2, 2004 and the last survey occurred on March 31, 2005.

Some surveys were conducted with favorable conditions throughout the duration of the survey, and others were flown with favorable conditions during part of the survey. Favorable conditions were considered to consist of a Beaufort force 3 or less and visibility of at least 3 nautical miles.

During the 2005 season, 44 complete surveys ($\geq 90\%$ of survey area flown) and 34 partial surveys ($< 90\%$ of survey area flown) were flown. Thus, some aerial survey coverage was provided 64% of the days. When a partial survey was conducted, effort priority was given to the shipping channels (St. Marys River entrance channel and St. Johns River entrance channel) and the immediate surrounding area.

Of the 34 partial surveys flown during the season 32 of them gave survey coverage to the St. Marys River entrance and the St. Johns River entrance channels. One of the 34 partial surveys flown was limited to covering only the St. Marys River entrance due to inclement weather. On the other survey the aircraft was called off effort to standby an entangled whale only after covering the area around and St. Marys River entrance. During this survey the team called in assistance from FWRI's aircraft, which was able to cover the St. Johns River entrance.

The number of days on site was multiplied by the on-transect miles per survey (Table 1) in order to evaluate how much of the available effort for the season was conducted in favorable sighting conditions (Beaufort ≥ 3 and visibility > 3 nm). There are 406 on-transect miles to be flown per survey; so 49,126 nautical miles were available to be flown during the 2005 season (121 days x 406 nm). During the 2005 season 27,958 of the available 49,126 nm were flown (57%). Of the 27,958 nm of track line that was flown, 20,152 nm were flown in favorable conditions (72%). Thus, 41% of the total miles available to be flown during the season were flown in favorable conditions.

**Table 1:
Survey Effort
2004-2005**

Number of Available Survey Days	Number of Surveys Flown/ Percent	Number of Full Surveys	Number of Partial Surveys	Number of Available Transect Miles (nm)	Number of Transect Miles Flown (nm)/Percent	Percent of Transect Miles Flown in Beaufort ≤ 3	Number of Transect Miles Flown in Beaufort ≤ 3 / Percent of Total Available
121	78	44	34	49,126	27,958		20,152
	64%				57%	72%	41%

Sightings and Photo-identifications

There were 146 right whale sighting in the Central EWS survey area during the 2005 season (Appendix 4). Of the 28 females known to have given birth in 2005, 27 were documented in the SEUS and 26 of them during the aerial survey season. Nineteen of the mother/calf (M/C) pairs were documented by the Central EWS surveys. All 146 sightings events were reported to the EWS pager system via FACSFACJAX and 145 of the sightings were photo documented. Of the 145 right whale sightings that were photo-documented, 25 of the sightings were of single whales (includes pregnant females), 69 were M/C sightings, 14 were whales associated in a SAG (SAGs ranged from 2-15 whales). Thirty-seven of the sightings were groups of 2- 4 whales (not associated in a SAG).

The first documented sighting in SEUS in the 2005 season was reported by the Central EWS survey on 7 December 2004. As the coastal, southern progression of right whales continued, the number of right whale sightings increased from 1 to a maximum of 10 sightings with as many as 26 individual whales documented in a single day. Sightings continued throughout the season with the last right whale sighting reported by the Central EWS on 20 March 2005. The occurrence of right whales in the survey area peaked in mid February. The temporal occurrence of right whales in the Central EWS area is summarized on a cumulative weekly basis in Figure 1.

All photo-documented right whale sightings from the 2005 season are plotted on a chart of the study area in Appendix 2. All sightings of right whales are detailed in a table in Appendix 4 with the date, time, location, association and behavior type where applicable of each whale. Also included are the catalog identification numbers when known.

Figure 1:
Temporal Occurrence of Right Whales in the SEUS

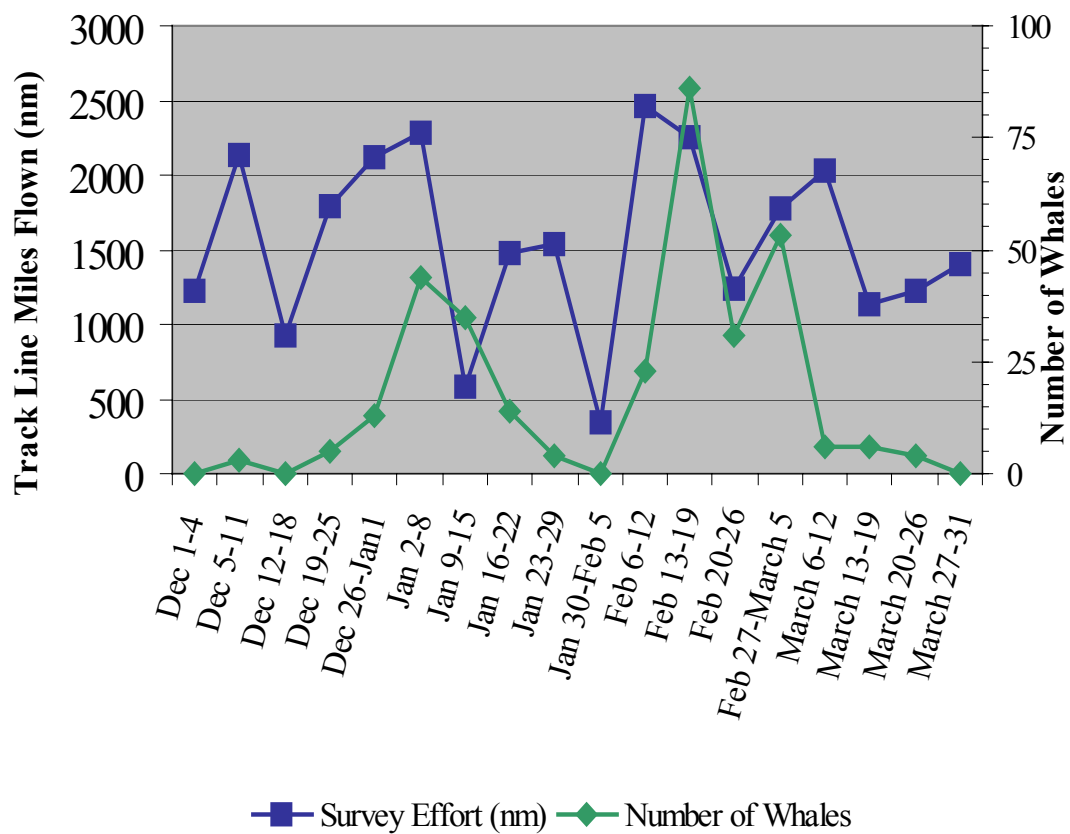


Table 2:
Demographics of Known Right Whales in the Central EWS

Right Whale	Age	Age Class	Sex	Comments
1012	U	A	F	
1013	U	A	Ff	
1039	25	A	Ff	
1145	U	A	Ff	
1158	U	A	Ff	
1179	U	A	Ff	
1241	23	A	Ff	
1245	23	A	Ff	
1303	U	A	Ff	
1308	22	A	Ff	
1310	U	A	Ff	
1334	U	A	F	
1408	21	A	Ff	
1427	21	A	m	
1604	U	A	F	
1622	U	A	Ff	
1632	U	A	F	
1703	18	A	Ff	
2143	14	A	Ff	Found dead with fetus
2223	13	A	Ff	
2413	11	A	U	
2425	11	A	Ff	Vessel strike 03-10-2005
2413	11	A	U	
2430	U	A	f	
2611	9	A	f	
2614	9	A	f	
2790	U	A	Ff	
3160	4	J	U	
3210	U	J	U	Entangled**
3314	2	J	U	Entangled *
3346	2	J	M	Entangled**
3351	2	J	U	
BK02	U	U	U	Unique individuals without ID numbers in the catalog
BK03	U	U	U	
BK04	U	U	U	
BK08	U	U	U	
BK10	U	U	U	

*Photographed outside of the Central EWS survey area. Central EWS aircraft responded to report of entangled whale.

** Previously known entangled

J-Juvenile (1-8 years)

A-Adult (>9)

U-Unknown

F-Female (direct observation of genital area)

f-Female (determined genetically)

M-Male (direct observation of genital area)

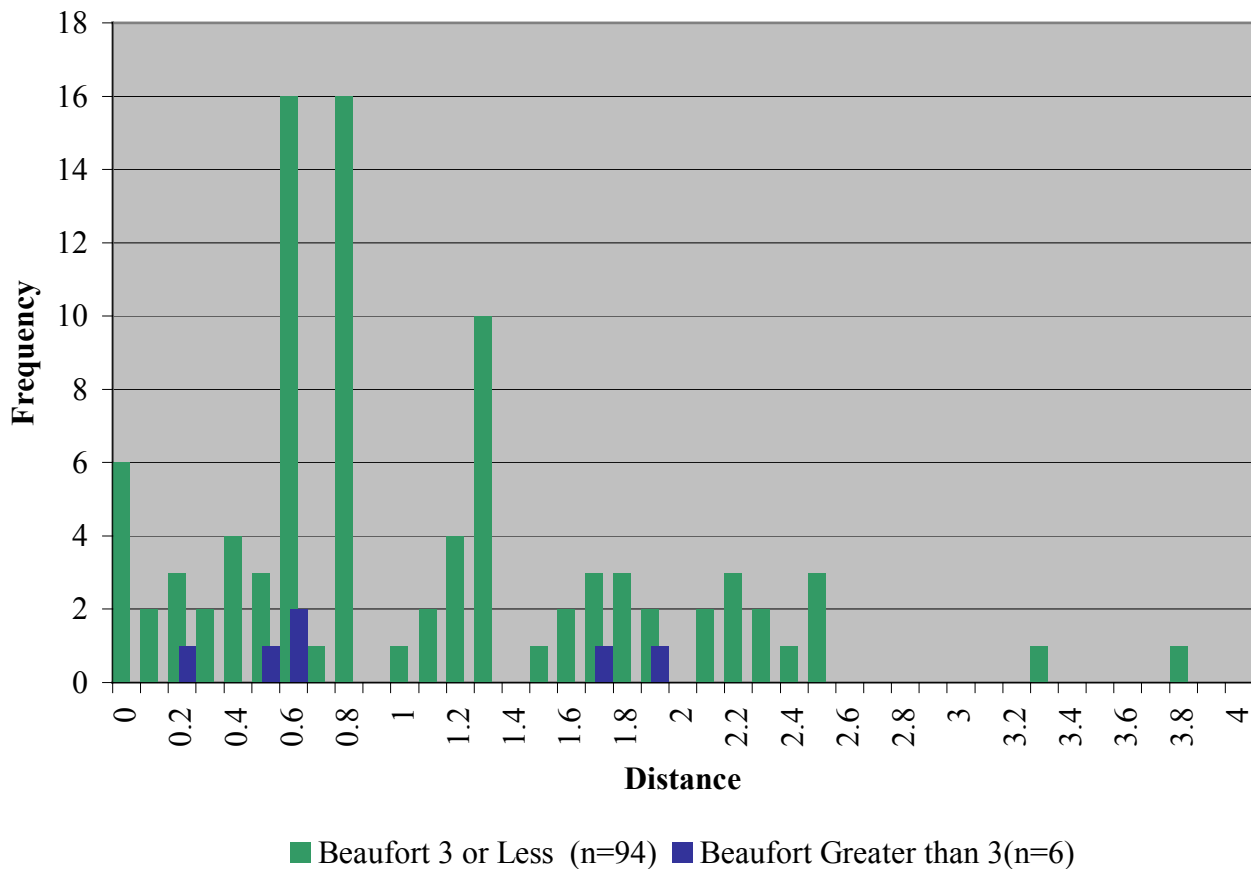
m-Male (determined genetically)

Sighting Distances

The sighting distances for each right whale sightings are summarized by 1/10 nm increments in Figure 2. Sighting that occurred while the survey aircraft was not on transect were not included in this analysis.

The mean sighting distance, without considering Beaufort sea state conditions as a factor is 1.1 nm. A summary of sighting distances where Beaufort sea state was considered is shown in Figure 2. Analysis of Beaufort sea state and sighting distances shows a mean of 1.1 nm during times of Beaufort 3 or less. While the mean during times of Beaufort 4 or greater is 1.06 nm, the frequency is reduced considerably (n = 92 and 6, respectively), however, only 28% of the survey track line miles were flown in a Beaufort 4 or greater. Only 5.2% of the sightings were detected in the higher sea state suggesting a reduced total sighting ability in the higher sea states.

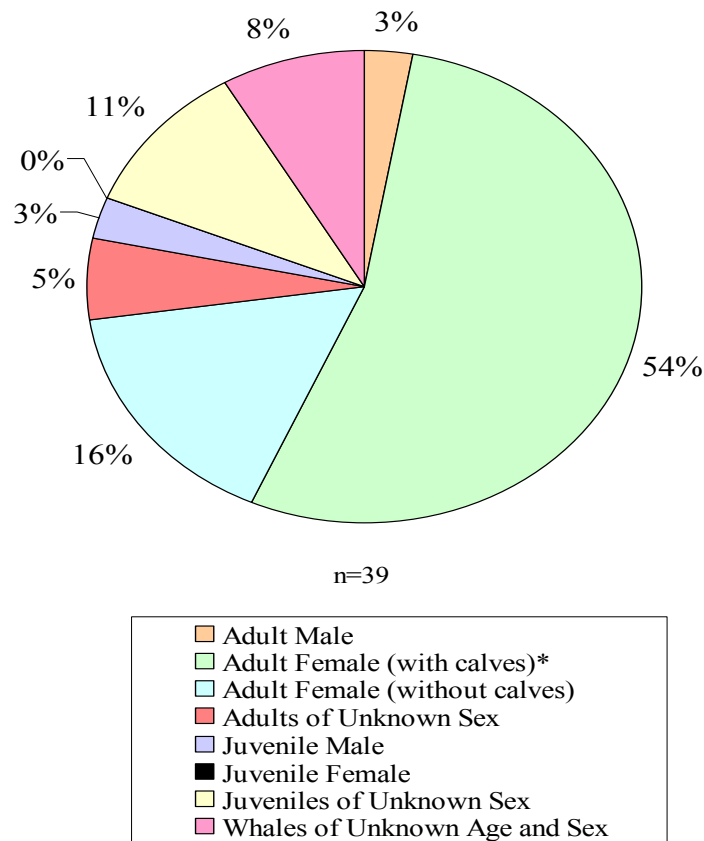
Figure 2:
Right Whale Sighting Distance



Demographics

A summary of the demographics structure within the Central EWS 2005 survey area is given in Figure 4. This figure indicates that calving females with their newborn calves primarily utilize the area. However, Figure 4 illustrates that juveniles also frequently were observed. In addition, matching, confirming and inter-matching of unidentified whales, thought to be juveniles, are currently underway. Once this process is complete it is likely that the number of individuals will increase which may lead to a shift in the demographic structure of the survey area.

Figure 4:
Demographics of Right Whales Documented in the Central EWS



* #2143 was found dead with a full term fetus and is included as an Adult Female (with calf).

Calving Intervals and Rates

Preliminary data from the 2005 calving season shows the calving interval ranged from 3-8 years with a mean of 3.8 (3.7 within the Central EWS area). Table 3 includes the year of the last calving event for each of the 2005 cows identified in the Central EWS in 2005.

During the 2005 season, four (three in the Central EWS) female right whales (#2223, #2413, #2645 and #2790) gave birth for the first time. A 13-year-old female #2223; #2413 is an 11-year-old female; #2645 is a 9-year-old female while #2790 is an adult female of unknown age. Right whale #2143, a 14 year-old female, was pregnant with her first known calf when she was found dead on the calving ground.

Table 3:
Calving Interval of Right Whales Documented in the Central EWS
2005

Right Whale	Age	Age Class	Last Calving	Calving Interval (years)
1012	U	A	2001	4
1013	U	A	1997	8
1039	25	A	2001	4
1145	U	A	2002	3
1179	U	A	2002	3
1241	23	A	2002	2
1245	23	A	2001	4
1303	U	A	2001	4
1308	22	A	2001	4
1310	U	A	2002	3
1334	U	A	2000	5
1408	21	A	2002	3
1604	U	A	2002	3
1622	U	A	2002	3
1632	U	A	2002	3
1703	18	A	2001	4
2143*	14	A	N/A	
2223	13	A	First Calving	
2413	11	A	First Calving	
2790	U	A	First Calving	

* Found dead but was pregnant with first known calf.

Associations

During the 2005 season all right whale association types were documented except for echelon feeding. Appendix 5 summarizes all association types observed during each right whale sighting event.

Vessel Sightings

Appendix 3 contains a chart on which the positions for all commercial and military vessels recorded during the 2005 season are plotted.

During the 2005 season the survey aircraft documented four “close call” events. Of the four “close call” events, two were forwarded to NOAA law enforcement for possible harassment and violation of the 500-yard rule. In addition, the aircraft often had communications with vessels directly to alert them of the presence and/or close proximity of a right whale(s) in order to avoid a “close call” situation. Table 4 summarizes the “close call” events documented.

On 24 February 2005 the Central EWS survey aircraft responded to a report of a possible vessel strike between a hopper dredge and a large whale (species unknown). The dredge was working in the Brunswick channel and was on a return trip from the disposal site when the incident occurred. The survey aircraft responded to the area and contacted the dredge. The survey aircraft stayed on site for over two hours and flew a box pattern at one nautical mile intervals out to six nautical miles in each direction of the initial report. The survey team documented one M/C pair twice during the search. The M/C pair had no visible (from the aircraft or photographs) external sign of a vessel interaction.

Table 4:
“Close Call” Events Documented in the Central EWS
2005

Date	Time (L)	Origin or Destination of Vessel	Number of Whales	Vessel Type and size (ft)	Communication	Closest Distance (estimated)	Vessels Action/ Whales Reaction
13-Feb-05	1427	Unknown	9	50-60 ft power boat	Yes, aircraft hailed the vessel (marine VHF Ch. 16). Vessel understood and slowed speed to less than 5 knots and altered course to avoid whales.	0.25 nm	Slowed speed and altered course. Whales had no apparent behavior change (SAG)
13-Feb-05	1427	Unknown	9	55-65 ft power boat	Aircraft hailed vessel (marine VHF Ch. 16) twice with no response.	300-400 meters	Vessel took no action. Whales had no apparent behavior change (SAG)
13-Feb-05	1450	Jacksonville Beach, FL	4	(4) Kayaks	No communication	20-30 meters	Kayaks approached whales. Whales had no apparent behavior change (logging).
13-Feb-05	1605	Jacksonville, FL	7	21-26 ft center console with twin outboards	Aircraft hailed vessel (marine VHF Ch. 16) four times with no response.	10-20 meters	Approached SAG. Once SAG broke up the vessel pursued individuals.

Entangled Whales

During the 2005 season the Central EWS survey documented the presence of three entangled right whales in the Southeast U.S. calving ground. During one of these entanglement events the Central EWS aircraft was relocated outside of the Central EWS survey area to offer support to disentangling efforts. All cases of entangled right whale sightings were reported to the southeast right whale coordinator, southeast regional stranding coordinator, Provincetown Center for Coastal Studies and appropriate state agencies as soon as the entanglement was confirmed. All cases of entangled right whales reported during the 2005 season by the Central EWS are summarized in Table 5.

Table 5:
Entanglements-Central EWS
2004-2005

Date	Action Taken	Known Entanglement/New Entanglement	Right Whale	Sex	Age
21-Dec-2004*	Stand-by, support disentanglement team for telemetry buoy deployment and photo- document	New Entanglement	#3314	Unknown	2
11-Jan-2005	Report and photo- document	Known Entanglement	#3346	Male	2
12-Jan-2005	Support disentanglement team and photo-document	Known Entanglement	#3346	Unknown	2
16-Feb-2005	Report and photo- document	Known Entanglement	#3210	Unknown	Unknown

*Entangled right whale located outside the Central EWS survey area.

Mortality

On 12 January 2005 during a standard Central EWS survey the team sighted, documented and reported a dead right whale. The carcass was floating high which allowed the observers to sight it over two miles from the track line. The dead right whale was documented with at least two white sharks feeding on it. On 13 January 2005 the Central EWS team relocated the carcass for recovery purposes and directed the towing vessel to the carcass.

The dead right whale was later identified as #2143, a 14 year-old female. The necropsy of this whale revealed that at the time of her death she was pregnant with a near full term fetus. This would have been her first calf. As a calf, #2143 was struck by a vessel (unknown type and size) in the Southeast U.S. The ship strike left her with a series of large prop wounds along her left flank. One of these wounds had reopened and became infected. The cause of death is still pending awaiting final histology analysis of skull fractures.

Discussion

The critical habitat of the coastal waters of the Southeast U.S. is currently the only known calving ground for the North Atlantic Right Whale. For over 10 years there has been extensive survey effort in the calving ground in the form of EWS surveys. Originally, the EWS surveys were designed to reduce the potential for ship strikes in the calving ground. However, over the past 10 plus years, the EWS surveys have proven to be more than a conservation tool to reduce the threat of ship strikes. In addition to the main objective of the EWS, these surveys have contributed hundreds of photo documented right whale sightings. These data play an imperative role in the understanding of right whale habitat, distribution, associations and reproduction.

Identification of all the right whales photographed in the Southeast U.S. in 2005 is currently being conducted. At least 28 (27 during the December- March aerial survey season) M/C pairs are known to have been observed in the calving ground (including South Carolina). The Central EWS team documented the presence of at least 19 (67.8%) of these M/C pairs.

Of the 28 M/C pairs known to be in the Southeast U.S. calving ground (including South Carolina), one (3.6%) had previously calved in 2000, eight (28.6%) of them had previously calved in 2001, 13 (46.4%) previously calved in 2002, five (17.8%) had never calved before and only one (3.6%) had a calving interval higher than five years. The mean calving interval using preliminary, contributed data for all known 28 M/C pairs (one documented after the end of the EWS season in April) in 2005 is 3.7 years, which indicates an improvement when compared to the average documented in the late 1990's. The mean calving interval for this population between 1993-1998 was over 5 years and had increased from 3.67 between 1980-1998 (Kraus et al., 2001).

By using contributed data from other survey groups (Associated Scientists at Woods Hole, Florida Conservation Commission (FWRI), Georgia Department of Natural Resources, South Carolina Department of Natural Resources and Wildlife Trust) a better understanding of how right whales use the critical habitat in the southeast U.S. is being developed. Though all the individuals have not been identified, preliminary analysis indicate at least 16% (n=7) of non-M/C pairs were juveniles, many of which were involved in SAGs. Since the Southeast U.S. is not a feeding ground, the presence and the behavior of these non-M/C pairs suggests the habitat may serve as a social function, at least in some years. The high number of calves born in the past four years and the documented increase in juvenile presence in the Southeast U.S. warrants further exploration to define this additional function of the calving ground.

The teamwork of many agencies and interests remains essential to the effectiveness of these surveys in mitigating collisions with right whales. The ability of the survey teams to alert FACSJAX, Naval Air Station, Jacksonville from as far as 30-35 nm from shore is the crucial component of this network. This allows FACSJAX the ability to acknowledge the right whale sightings data from the survey team and initiate many notifications via pagers and the NAVTEX system. U. S. Coast Guard

(USCG) Office of Aids to Navigation in Miami transmits the NAVTEX notification. These are the primary means for contacting commercial shipping interests with right whale locations. The USCG also transmits Notice to Mariners over VHF marine-band radio and updates the Mandatory Ship Reporting (MSR) system. Simultaneously, the Harbor Pilot Associations at the ports of Jacksonville, Fernandina and Brunswick monitor pagers for information transmitted by FACSFACJAX and relay this information to ships being piloted to/from their respective ports. This transmission of near-real time data, which propels a chain reaction of alerts and notifications along the coastline of the southeastern United States, is what distinguishes these aerial surveys as a meaningful conservation tool.

The risk to right whales created by large, fast moving, recreational vessels should also be viewed as a threat. Since the Southeast U.S. is a calving ground, the potential for recreational vessels to cause harm to right whales (specifically calves) is high. In March of 2005 a 43 ft recreational vessel traveling at approximately 20 knots struck an adult, female right whale. The vessel caused a serious injury to the fluke of the whale. While it is likely that the whale (#2425) will survive the injury it is unknown how much damage that type of impact would have on a young calf. In the past 10 years, awareness has improved among the recreational boating community but this should be viewed as an area where much improvement is needed. The increase in the observed number of documented recreational vessels in violation of the 500-yard approach rule is also a growing concern and should be aggressively approached by law enforcement.

In some cases (“close calls”) we believe the EWS surveys have proven to be an effective tool in the prevention of ship strikes in the calving ground. However, the EWS surveys still face limitations in their ability to prevent ship strikes on a 24-hour basis. Limitations include reduced visibility and weather too severe for survey aircraft to be launched. In addition, telemetry data (Slay *et al.*, 1997) indicate that the EWS surveys may locate only 50% of the right whales in the area when conditions are favorable. Further, the effectiveness of the EWS system is unknown, since there is no information on how shipping traffic (commercial and military) responds to right whale reports. It is currently unknown, when an EWS sighting report is transmitted, if a ship avoids the reported area, if a ship’s speed is reduced, or even if more lookouts are posted. These are all critical factors in determining if the EWS is a useful tool in the prevention of ship strikes. If none of those preventative measures are taken by ships traveling in the critical habitat than the risk to right whales has probably not been reduced.

The conservation measure that is ultimately needed in the calving ground is a right whale reporting system that is not based on the ability of a survey team to visually locate, on a daily basis, the location of all right whales. Aerial surveys should be recognized as a tool for collecting data on the distribution and occurrence of right whales but not as a system that can consistently prevent ship strikes over an extended period of time. The communication of right whale sightings from the EWS surveys to the shipping community has likely reduced the potential for ship strikes through continuing education and increased awareness to mariners, but it is not an infallible plan to eliminate the

potential of ship strikes to right whales in the Southeast U.S. Given the recent high levels of ship-cause mortality in the mid Atlantic by females enroute to the calving grounds (Kraus et al, 2005), the reduction of mortalities in reproductive females must take these aerial survey limitations into consideration. Right whales do not need more aerial surveys, but they do need a better response from commercial and military ships.

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Acknowledgements

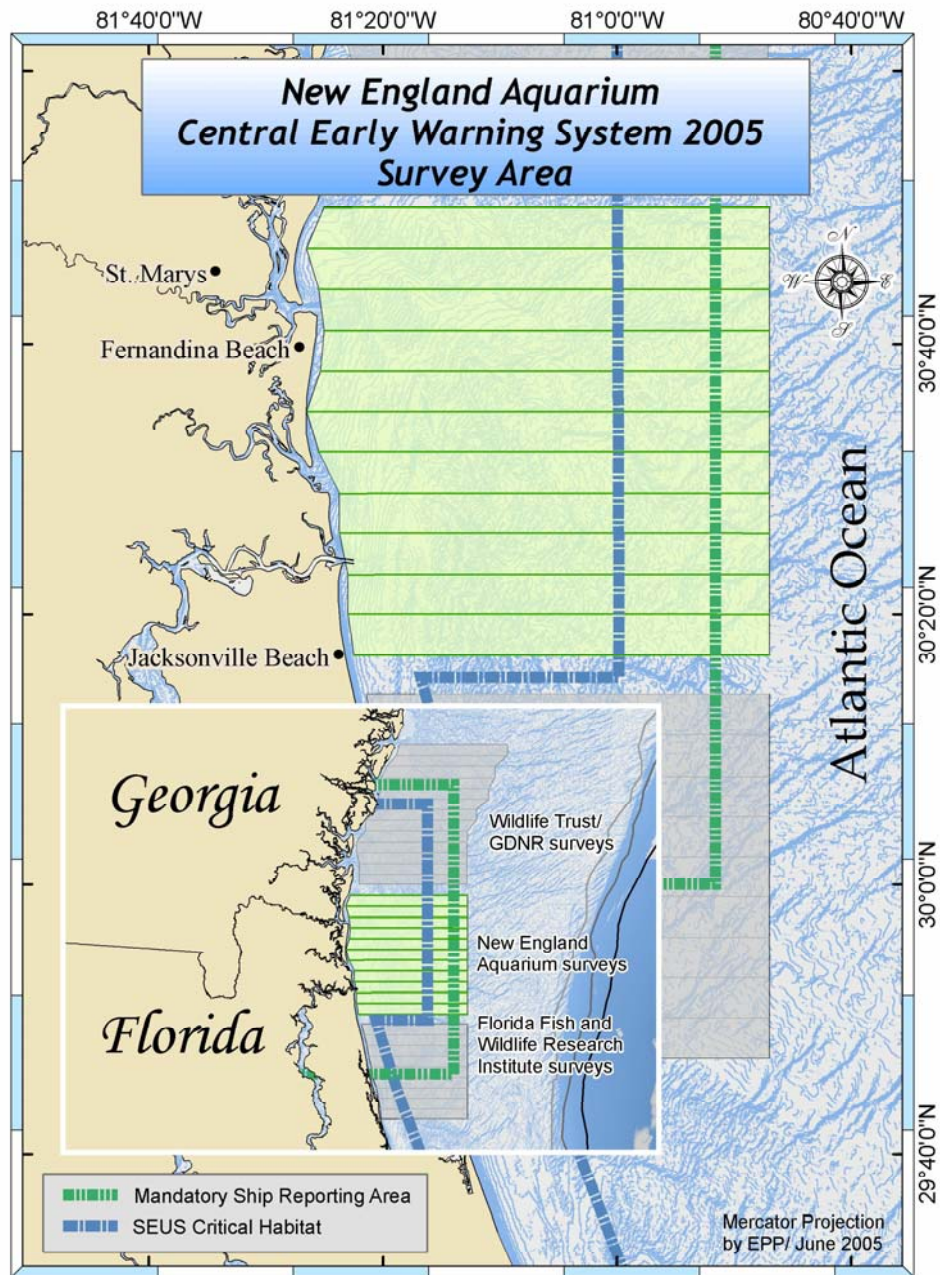
First and foremost we must mention and thank the Central EWS right whale observers of 2005. These surveys would never be possible without the loyalty and extreme dedication of a team of highly qualified individuals. The New England Aquarium's Central EWS team consisted of Lindsay Hall, Brenna Kraus, Elizabeth Tuohy-Sheen and Jessica Taylor.

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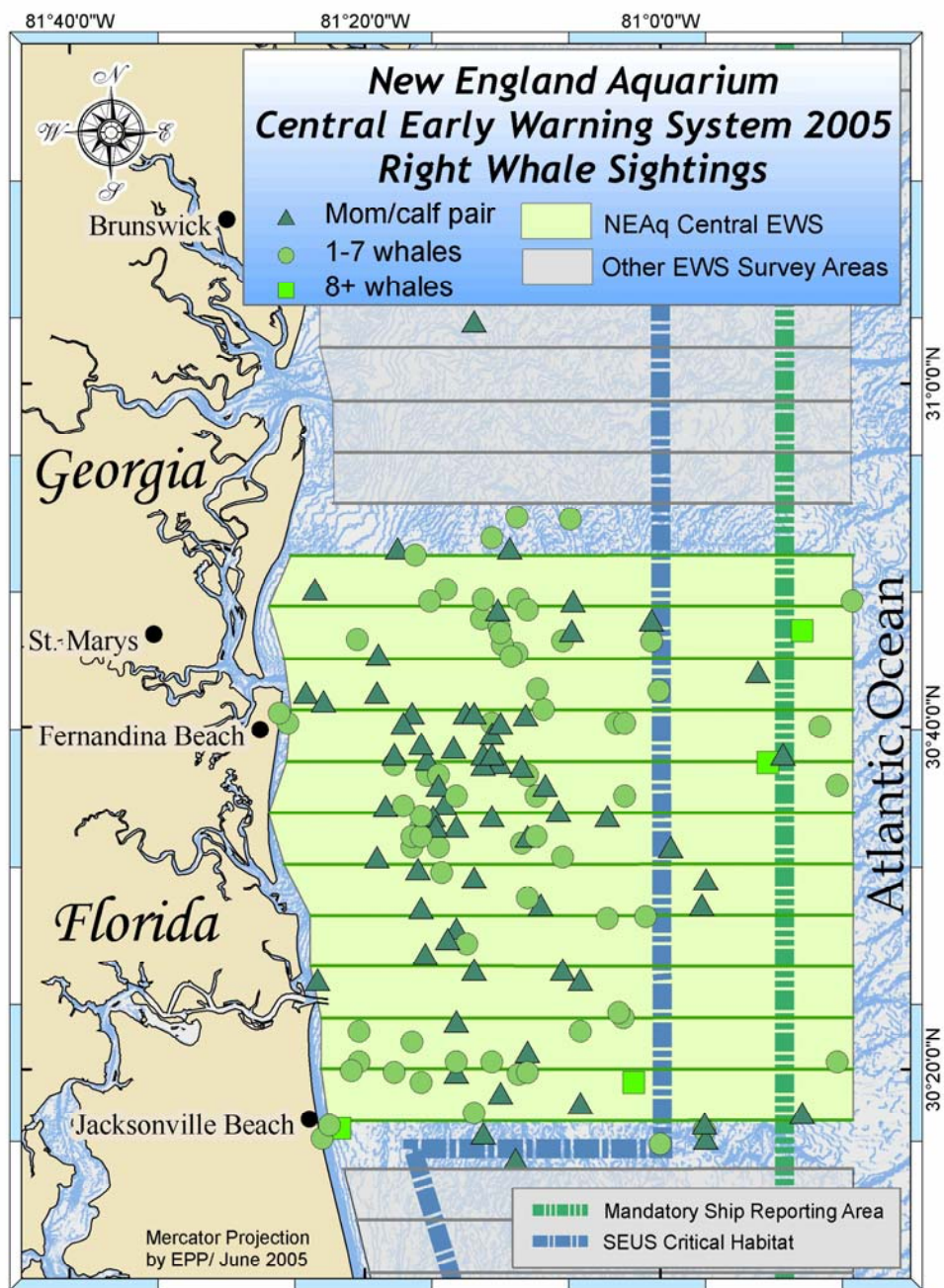
The dedicated support from the New England Aquarium's Right Whale Research Team in Boston was a constant help throughout the field season Lisa Conger, Laura Lane-Cooke and Philip Hamilton.

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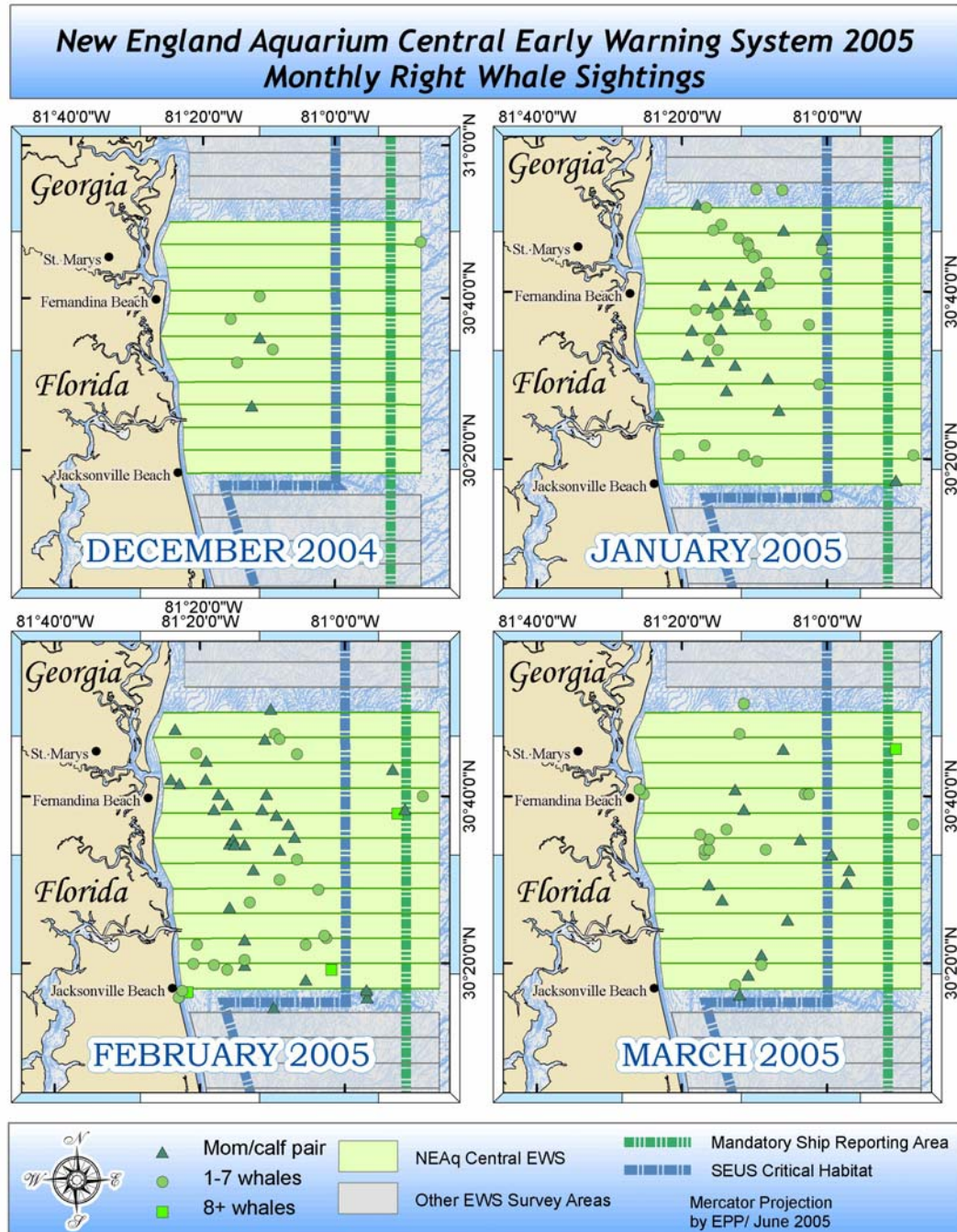
Appendix 1



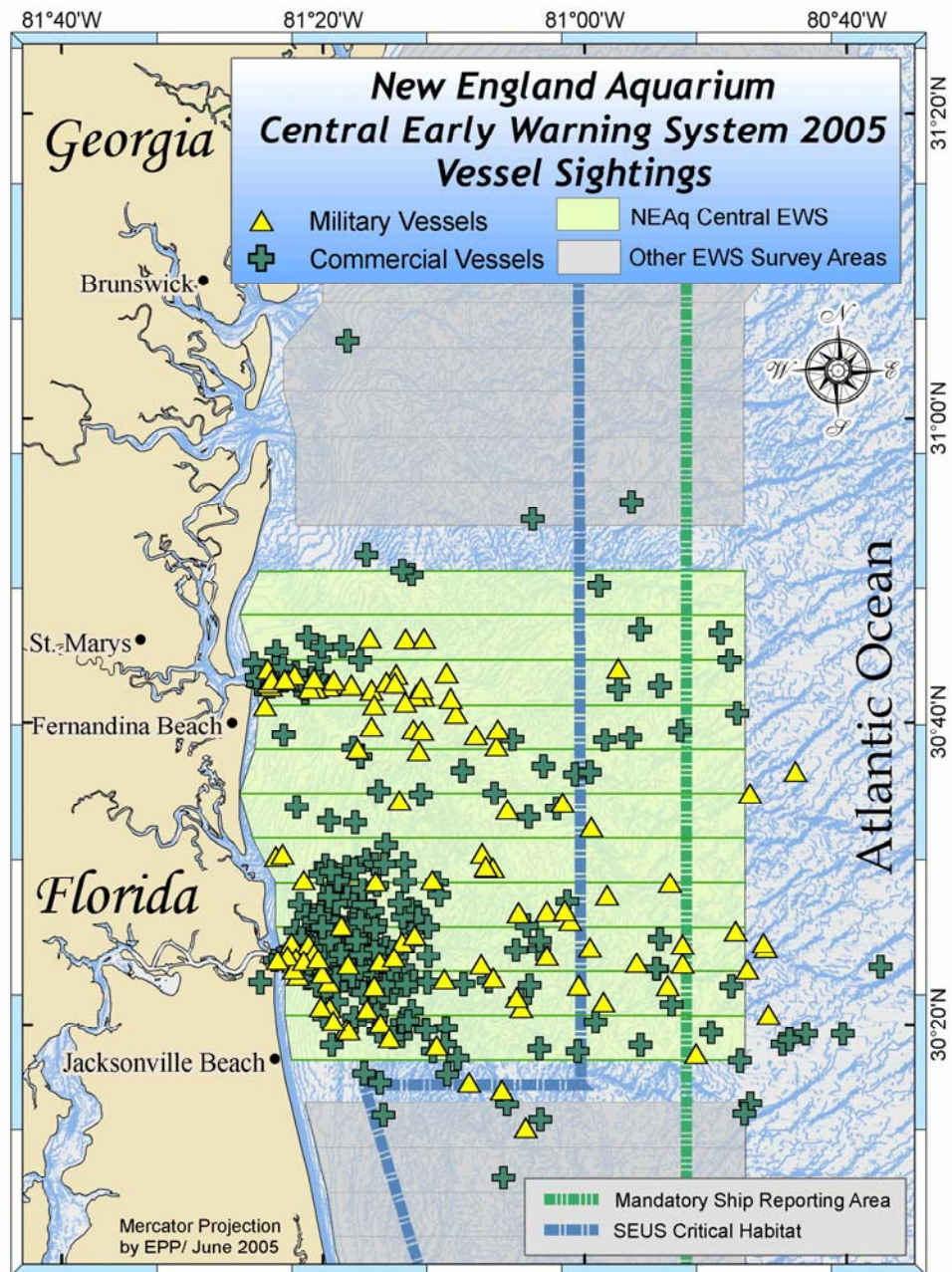
Appendix 2



Appendix 3



Appendix 4



Year	Month	Day	Time (L)	Latitude	Longitude	Right Whale Catalog Number	Association Type	Behaviors/Comments
2004	12	7	1153	30.52500	-81.24667	1245 1622	Other	
2004	12	9	1345	30.78833	-80.78333	1622	Singleton	
2004	12	21	1328	31.51000	-81.01000	3314	Singleton	ENTGL, W/TELBUOY
2004	12	29	1134	30.58000	-81.19000	1039	Mother/Calf	BODO
2004	12	29	1230	30.43000	-81.21000		Mother/Calf	BODO
2004	12	24	1026	30.67000	-81.19000		Other	BOD CNT, FLIP, ROLL, UW EXH BOD CNT, FLIP, ROLL
2004	12	22	1206	30.55333	-81.15667	2790	Other	BRCH, ROLL
2004	12	30	1049	30.62000	-81.26333		Other	
2005	1	1	0948	30.80000	-81.24167	2143	Singleton	UW EXH
2005	1	1	1103	30.64667	-81.23333	1039	Mother/Calf	
2005	1	1	1443	30.49333	-81.13500	1632	Mother/Calf	BOD CNT, ROLL
2005	1	1	1610	30.63167	-81.18167	1039	Mother/Calf	
2005	1	2	0954	30.78833	-81.09833	1241	Mother/Calf	BOD CNT
2005	1	2	1116	30.63500	-81.26333	1039	Mother/Calf	BOD CNT, BODO
2005	1	2	1155	30.59167	-81.24333		Mother/Calf	BOD CNT
2005	1	2	1506	30.32833	-81.16000	1158	Other	BODO
2005	1	3	0947	30.87000	-81.16167	2143	Singleton	
2005	1	3	1120	30.66000	-81.19000	1039	Mother/Calf	
2005	1	3	1506	30.29000	-80.84000	1013	Mother/Calf	
2005	1	4	1345	30.52833	-81.27333	1632	Mother/Calf	NURS
2005	1	4	1446	30.67833	-81.15167	1039	Mother/Calf	
2005	1	5	1329	30.55000	-81.25000	2143 2790 2143 2790	Other	
2005	1	5	1434	30.54000	-81.32000	1632	Mother/Calf	
2005	1	5	1625	30.84000	-81.29667	1241	Mother/Calf	
2005	1	6	0952	30.34000	-81.19000	1158 2425	Other	BOD CNT BOD CNT, HDLFT
2005	1	7	1242	30.60000	-81.04000	1308	Singleton	
2005	1	7	1313	30.59000	-81.31000	1632	Mother/Calf	

Year	Month	Day	Time (L)	Latitude	Longitude	Right Whale Catalog Number	Association Type	Behaviors/Comments
2005	1	7	1448	30.34000	-81.34000	BK04	Other	BODO, WH CHN
						2430		BODO
2005	1	8	1128	30.26000	-81.00000	1334	Other	
2005	1	8	1222	30.43000	-81.11000	1039	Mother/Calf	
2005	1	8	1314	30.60000	-81.14000	2425	Other	BOD CNT
						1158		
2005	1	8	1323	30.62000	-81.15000		Other	
						3351		
2005	1	8	1407	30.63000	-81.20000	1703	Mother/Calf	
2005	1	9	1015	30.36000	-81.28000		Other	
2005	1	9	1354	30.62000	-81.25000		Singleton	BRCH
2005	1	9	1454	30.63000	-81.30000		Other	BRCH, MOPN, YRLG W/MOM
						2614		W/YRLG
2005	1	11	1408	30.73833	-81.16167	3346	Other	ENTGL, LN GONE
2005	1	11	1414	30.74667	-81.17833		Other	W/UNPH EG
2005	1	11	1457	30.70167	-81.00167		Other	
2005	1	11	1612	30.48167	-81.01667		Other	
						1334		
2005	1	12	0920	30.83333	-81.27667	BK04	Other	
						2430		
2005	1	12	0943	30.77167	-81.20167	BK08	Other	
2005	1	12	1003	30.86833	-81.10167	2143	Singleton	FLTG DEAD
2005	1	12	1127	30.76333	-81.18167		Other	BOD CNT, BODO
						BK08		
2005	1	12	1200	30.78833	-81.26000		Singleton	BRCH, LBTL
2005	1	12	1232	30.75833	-81.18000	BK08	Other	
2005								
2005	1	12	1309	30.68333	-81.13167		SAG	BEL/BEL, SAG
						BK03		
2005	1	12	1335	30.70333	-81.13833		Singleton	LBTL
2005	1	12	1505	30.42000	-81.38667	1622	Mother/Calf	
2005	1	12	1621	30.73500	-81.16833	3346	Other	ENTGL
2005								
2005	1	19	1016	30.75000	-81.01000		Other	
2005								
2005	1	19	1024	30.77000	-81.01000	1179	Mother/Calf	

Year	Month	Day	Time (L)	Latitude	Longitude	Right Whale Catalog Number	Association Type	Behaviors/Comments
2005	1	19	1155	30.68000	-81.28000	1632	Mother/Calf	
2005	1	19	1625	30.52000	-81.21000	2413	Mother/Calf	
2005	1	21	1456	30.34000	-80.80000	2430 2790	Other	
2005	1	22	1406	30.57000	-81.27000	BK04	Singleton	
2005	1	22	1438	30.47000	-81.23000		Mother/Calf	BOD CNT
2005	1	25	1130	30.68000	-81.22000	1308	Mother/Calf	
2005	1	25	1444	30.64000	-81.20000	1012	Mother/Calf	
2005	2	7	1307	30.64000	-81.19000	1408	Mother/Calf	MOPN
2005	2	9	1117	30.57167	-81.26500	1703	Mother/Calf	
2005	2	9	1402	30.38000	-81.23000		Mother/Calf	
2005	2	10	1140	30.78000	-81.18333		Mother/Calf	BODO
2005	2	10	1419	30.62833	-81.15667		Mother/Calf	
2005	2	11	1425	30.37000	-81.09000		SAG	BEL/BEL, SAG
2005	2	11	1529	30.48000	-81.06000	2611	Other	
2005	2	12	1048	30.58000	-81.25667	1632	Mother/Calf	BODO
2005	2	12	1107	30.57000	-81.23000		Mother/Calf	
2005	2	12	1449	30.57000	-81.25333	1632	Mother/Calf	BODO
2005	2	13	1006	30.73667	-81.31833	1632	Mother/Calf	
2005	2	13	1008	30.75167	-81.34167		Singleton	
2005	2	13	1427	30.27500	-81.36167		SAG	SAG, BODO
						3314		
						BK08		

[illegible]

Year	Month	Day	Time (L)	Latitude	Longitude	Right Whale Catalog Number	Association Type	Behaviors/Comments
2005	2	16	1337	30.66667	-80.82000		Other	
2005	2	16	1353	30.64000	-80.86167	1245	Mother/Calf	
2005	2	16	1729	30.56000	-81.15000	1245	Mother/Calf	
2005	2	17	1228	30.67000	-81.29000	1310	Mother/Calf	
2005	2	17	1420	30.61000	-81.13000	1245	Mother/Calf	
2005	2	17	1459	30.58500	-81.11500	2223	Mother/Calf	
2005	2	17	1703	30.26500	-80.94833	1241	Mother/Calf	
2005	2	17	1721	30.24500	-81.16333	1604	Mother/Calf	
2005	2	19	0914	30.79000	-81.16000		SAG	BODO, SAG
					BK02			
2005	2	19	0929	30.78000	-81.15000		Other	
2005	2	19	1010	30.75000	-81.11000	BK10	Singleton	
2005	2	19	1035	30.80000	-81.39000	1310	Mother/Calf	
2005	2	19	1127	30.67000	-81.18000	1145	Mother/Calf	BODO
2005	2	19	1139	30.70000	-81.32000	1703	Mother/Calf	
2005	2	19	1152	30.65000	-81.27000	1408	Mother/Calf	
2005	2	19	1409	30.61000	-81.25000	1408	Mother/Calf	
2005	2	19	1423	30.52000	-81.21000	1241	Mother/Calf	NURS
2005	2	19	1551	30.32000	-81.23000	1604	Mother/Calf	NURS
2005	2	20	1034	30.34000	-81.23000	BK04	Singleton	
2005	2	20	1151	30.64000	-81.30000	1408	Mother/Calf	
2005	2	20	1452	30.84000	-81.17000	1310	Mother/Calf	LBTL
2005	2	20	1634	30.50000	-81.15000		SAG	BEL/BEL
2005								
2005								
2005								
2005								
2005								

Year	Month	Day	Time (L)	Latitude	Longitude	Right Whale Catalog Number	Association Type	Behaviors/Comments
2005	2	21	1352	30.28000	-80.95000	1303	Mother/Calf	
2005	2	21	1413	30.30000	-81.09000	1604	Mother/Calf	
2005	2	22	1638	30.44500	-81.26500		Mother/Calf	
2005	2	22	1652	30.38333	-81.04167		Singleton	
2005	2	22	1656	30.38833	-81.04667		Singleton	
2005	2	24	1347	31.06000	-81.21000	1334	Mother/Calf	
2005	2	24	1643	30.32000	-81.27000		Other	BRCH
2005								
2005	2	24	1648	30.33000	-81.30000		Other	
2005	2	24	1738	30.37000	-81.34000	BK08	Other	BODO
2005	2	28	1354	30.45500	-81.21833		SAG	SAG
2005	2	28	1444	30.54000	-81.11000		SAG	SAG
2005	2	28	1628	30.72000	-80.89000	1303	Mother/Calf	NURS
2005	3	2	1436	30.55000	-81.28000		Other	
2005	3	2	1455	30.56000	-81.28000		SAG	SAG, W/UNPH EG
2005	3	2	1511	30.56000	-81.27000		Singleton	
2005	3	2	1540	30.60000	-81.23000		Other	
2005	3	3	1009	30.42000	-81.09000	1632	Mother/Calf	NURS
2005	3	3	1120	30.58000	-81.27000		Singleton	
2005	3	3	1150	30.59000	-81.29000		Singleton	
2005	3	3	1413	30.77000	-81.24000		Other	BODO
2005	3	3	1501	30.85000	-81.19000		Other	BOD CNT
2005	3	4	0924	30.31000	-81.18000	1310	Mother/Calf	BRCH, W/CALF
2005	3	4	1010	30.35000	-81.15000		Mother/Calf	
2005	3	4	1329	30.33000	-81.15000		Other	
2005	3	4	1346	30.29000	-81.21000		Singleton	
2005	3	4	1355	30.27000	-81.20000	1310	Mother/Calf	
2005	3	4	1432	30.61000	-80.80000		Singleton	

Year	Month	Day	Time (L)	Latitude	Longitude	Right Whale Catalog Number	Association Type	Behaviors/Comments
2005	3	4	1501	30.64000	-81.19000	1632	Mother/Calf	
2005	3	4	1530	30.67000	-81.05000		Singleton	
2005	3	4	1539	30.67000	-81.04000		Singleton	
2005	3	4	1659	30.79000	-81.20000		SAG	BEL/BEL, SAG
2005	3	5	1126	30.58000	-81.06000	1604	Mother/Calf	
2005	3	5	1200	30.68000	-81.21000	2413	Mother/Calf	NURS
2005	3	5	1445	30.76000	-80.84000		SAG	SAG
						3160		
2005	3	6	1330	30.76000	-81.10000	1632	Mother/Calf	NURS,
2005	3	7	1014	30.46000	-81.24000	1308	Mother/Calf	
2005	3	7	1514	30.49000	-81.27000	1308	Mother/Calf	BOD CNT, BODO
2005	3	13	0941	30.67000	-81.42000		Singleton	
2005	3	13	1111	30.68000	-81.43000		Singleton	
2005	3	13	1206	30.56000	-81.14000		Other	
					1158			
2005	3	19	1134	30.55000	-80.98833	1334	Mother/Calf	
2005	3	20	1121	30.51833	-80.94833	1334	Mother/Calf	
2005	3	20	1537	30.49333	-80.95333	1334	Mother/Calf	
apparent nursing (NURS), belly to belly contact (BEL/BEL), body contact not belly to belly (BOD CNT), breach (BRCH), lobtail (LBTL), defecation (DEFKN), mouth open (MOPN), rolling (ROLL), associated with Bottlenose Dolphins (w/BODO), entangled (ENTGL) and SAG (surface active, group), head lift (HDLFT), underwater exhalation (UWEXH), line gone (LN GONE), with yearling (W/YRLG), floating dead (FLTG DEAD)								